owing to the more rapid movement of the belt in which they occur. Prof. E. E. Barnard observed the spots so early as May last (*Astronomische Nachrichten*, No. 3063). He found in September that they were decreasing their longitudes about 10° daily. At this rate they would describe a complete rotation round Jupiter, relative to the great red spot, in about 36 days. The daily loss derived from Mr. Denning's observations in August and September would bring the two spots in conjunction in about 39 days.

WOLF'S PERIODIC COMET.—The following ephemeris is from one given by Dr. Thraen in *Astronomische Nachrichten*, No. 3064:—

Ephemeris for Berlin Midnight.

1891.		Right Ascension. h. m. s.		Declination. ° ′ ″		Brightness.
Nov. 14	...	4 35 16	...	−8 29 28	...	10·2
,, 17	...	33 27	...	9 36 16		
,, 20	...	31 31	...	10 36 44	...	9·3
,, 23	...	29 31	...	11 30 38		
,, 26	...	27 31	...	12 17 51	...	8·3
,, 29	...	25 31	...	12 58 22		
Dec. 2	...	23 37	...	13 32 15	...	7·4
,, 5	...	21 48	...	13 59 40		
,, 8	...	20 8	...	14 20 51	...	6·5
,, 11	...	18 39	...	14 36 10		
,, 14	...	17 22	...	14 45 59	...	5·7
,, 17	...	16 17	...	14 50 41		
,, 20	...	15 26	...	14 50 38	...	4·9
,, 23	...	14 49	...	14 46 14		
,, 26	...	4 14 27	...	14 37 52	...	4·3

Although the comet is getting fainter and moving south, it may probably be followed to the last date in the above ephemeris with instruments of moderate aperture. The greatest southern declination of 14° 51′ 8″ is reached on November 18.

THE TOTAL LUNAR ECLIPSE OF NOVEMBER 15.—If atmospheric circumstances permit, a total eclipse of the moon may be observed over all Europe on Sunday next, November 15. The following are the times of contact with the earth's shadow given in the *Nautical Almanac*:—

		G.M.T. h. m.
First contact with the penumbra	... ...	9 36·7
,, ,, ,, shadow	... ...	10 35·1
Beginning of total phase	... ...	11 37·4
Middle of eclipse	... ...	12 18·9
End of total phase	... ...	13 0·4
Last contact with the shadow	... ...	14 2·7
,, ,, ,, penumbra	... ...	15 1·1

The first contact with the shadow occurs at 55° from the most northern point of the moon's limb counting towards the east, the last contact at 95° from the same point counting towards the west.

THE ELEMENTS OF THE MINOR PLANETS.—The *Viertel-jahrschrift der Astronomischen Gesellschaft* (first volume) contains two interesting compilations, on the planets discovered in the year 1890, and on the appearances of comets in the same year. The first paper is contributed by Dr. Paul Lehmann, and informs us that no less than fifteen new members of our minor planet system were discovered last year between February 20 and November 14. In the table that follows a summary of all the days on which each individual planet was observed is given, and this is succeeded by another which shows their chief elements. By combining the elements of some of the old planets with those of the new ones, some striking combinations are thus brought to light, of which we give the two following cases, in which the new planets are 292 and 288:—

Planets.				
152	☊ = 41°·3	i = 12°·2	ϕ = 4°·4	a = 3·15
13	43·2	16·5	5·0	2·58
99	42·0	13·9	13·8	2·80
155	43·1	14·1	14·8	2·91
292	43·1	14·7	2·4	2·53
268	☊ = 121°·7	i = 2°·0	ϕ = 7°·9	a = 3·09
288	121·6	4·4	11·6	2·75
113	123·1	5·0	5·0	2·38
213	122·4	6·8	8·3	2·75

The next table shows the values that have been obtained after computing the mean brightest and darkest magnitudes that the planets can attain. In the last form the tabulation is so arranged that the following numbers can be directly seen:—(1) The number of oppositions in which, up to the present time, places have been found, with the number of appearances since observed. (2) The number of every known opposition in which the planet has been observed. (3) Every planet to which the foregoing statement refers. (4) The number of these planets.

SOME EXPERIMENTS MADE WITH THE VIEW OF ASCERTAINING THE RATE OF PROPAGATION OF INDUCED MAGNETISM IN IRON.

THE question, considered in a simple form, may be put thus: Suppose a magnet were suddenly brought up to one end of a long iron rod, what length of time intervenes between the occurrence of magnetization at the near end and at the far end?

Everyone, probably, would at first be inclined to say that the speed along the bar would undoubtedly be about the same as the velocity of light, and this supposition would naturally follow if the energy to places along the bar be supposed transmitted through the surrounding space; but, on the other hand, the speed may be much less if the energy of magnetization is transmitted from particle to particle in the iron—the orientation of the molecular magnets being, as it were, passed from each to the next along the bar. In such case we would, of course, expect the velocity of propagation to be comparable in speed with that of molecular phenomena rather than that of disturbances in the ether.

The velocity of sound, with which we may, perhaps, compare it, is in iron about 16,000 feet per second. The transmission of sound resulting from vibratory movement can be said to depend on the mass of the molecule, and on the mutual forces keeping the molecules in position; while the rate of propagation of a magnetic disturbance of the kind supposed would depend on the moment of inertia of the particles (assumed to be molecular magnets) round their axes of rotation, and on their mutual magnetic moments.

The propagation of such a disturbance can be observed in Prof. Ewing's magnetic model. The model, which consists essentially of a great number of small compass needles placed within each other's action, but not near enough to touch, can be disturbed at one place by bringing a magnet near, or otherwise. The disturbance then is seen to spread throughout the model, much in the same manner as we have suggested a magnetizing disturbance to be propagated in iron.

The method proposed to test matters depended upon the principle of the interference of waves travelling in opposite directions observed through the production of stationary waves.

Thus, if a bar of soft iron have two coils of wire placed one at each end, and if the same alternating current be passed through both coils, disturbance of opposite signs travelling in opposite directions along the bar should interfere, provided the rate of alternation and the length of the bar are chosen suitable to the rate of propagation.

It was proposed to detect the nodes or places of interference by means of a telephone in circuit with a third coil which could be slid along the bar.

Instead of employing two alternating coils, the bar can be bent round to form a ring, and one coil will be then sufficient.

Some preliminary experiments with a straight bar having given faint indications of the existence of places of minimum intensity, closed magnetic circuits or rings, formed of a great number of turns of soft iron wire,[1] were then tried with more decided results. When the alternating coil was in certain positions on the ring the telephone coil could be placed at points where no sound, or if any very slight, could be heard—the sound reaching a maximum in places somewhere between these points. These nodes and internodes occupied about half the ring—the opposite half of the ring from that in which the alternating coil lay. On approaching nearer the alternating coil, apparently the very unequal length of the paths prevented any effect being observed.

It was without difficulty ascertained that these were not the

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[1] Two rings were made of No. 21 soft iron wire, one about 10 feet and the other 14·5 feet in circumference. Both had 8 pounds of wire wound on. The wire used in a third ring was No. 32. This ring was about 12 feet in circumference. There was about 4 miles of wire put on. The wire of this and the 14-feet ring was well coated with shellac before winding, so as to minimize Foucault currents.

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nodes looked for, because the distances between them remained unaffected on changing the rate of alternation. The distances from node to node also were found to measure different amounts (though on the whole there was a decided tendency towards regularity). The average distance apart of the nodes in the different rings tried lay between 10 and 18 inches.

The occurrence of the nodes might have been very well attributed to the ring being locally irregular in its susceptibility to induction, but for the irreconcilable fact that the effects on either side of a node were found to be of opposite phase, just as it would be, were the phenomenon due to stationary interference waves.

This was ascertained by means of two coils connected in the same sense in series with the telephone. When these coils were arranged at places of equal intensity, one on each side of a node, no sound was to be heard in the telephone, the effects neutralizing one another. A commutator, to throw in the coils singly or together as desired, is convenient for making this experiment.

From this, one would naturally assume that the currents induced on either side of a node must be of opposite sign, seeing that they neutralize each other in the telephone; but experiments with the galvanometer show it not to be the case. To test this, the galvanometer is connected up through a commutator arrangement fixed to the originator of the primary current in such a way as only to admit of the currents induced in one direction passing. Tried in this way, no difference in the direction of the current on either side of a telephone node was found, or, indeed, any trace of a minimum effect at these points. The thing can also be tested by means of a ballistic galvanometer, and a reversing key with battery, for, with a reversing key and telephone, the nodes, which are quite independent of the speed, are to be found, as well as the opposite phase effect. The ballistic galvanometer gives no indication of there being any difference at the nodes from elsewhere, and the deflection everywhere is in the same direction.

It was thought that perhaps the telephone effect was in some way connected with the fact that the form of the alternating current was not a simple wave or sign curve, owing to the method employed in producing it. This consisted of a rotating commutator, which threw in circuit alternately two cells connected up singly and in opposite directions. For this reason, the effect, when using a small alternating machine with about 40 alternations per second, was compared, and was found to be in no way different. Also what must have been a very regular variable current of the simple harmonic type was procured by means of a microphone and an organ-pipe. This gave like results.

One is thus left apparently to suppose the sound in the telephone to be due to a peculiarity in the character of the curve representing the rise and fall of the current, probably something of the nature of a subsidiary oscillation; this subsidiary oscillation being absent at the nodes, and of opposite sign on either side.

As mentioned before, it is necessary for the alternating coil to be placed at definite positions, in order that the system of nodes and internodes should occur. These positions of the alternating coil are at about the same average distance apart, and are of very much the same character with respect to regularity as the nodes of the telephone coil. In fact, if the alternating coil and the telephone coil change places round the ring, the best position for the alternating coil will always be between two nodes, and the nodes will be found situated between two old positions of the alternating coil. If the alternating coil be placed at a point where a node was found in some other position of the alternating coil, the system of nodes and internodes generally completely disappears, and now on moving the telephone coil round the ring the intensity uniformly diminishes until the diameter is reached, and then increases round the other half of the ring. This gives the phenomenon a distinctly resonant character. The induced current, as observed by a galvanometer, is always of the latter character—that is to say, a uniform fall, and then a rise on going round the ring.

As a rule the permanent magnetism of these large rings is irregular, and apparently apt to change frequently. A determination of the permanent magnetism was easily made by means of one of the coils connected with a ballistic galvanometer. By moving this through a given amount at a time, say an inch, and noting the throw of the needle, one was able to plot out a representation of the state of the permanent magnetism. In this way, places where no throw occurs were found, while to either side of such a point the throw changed sign. It was sometimes found that there was a decided tendency for the position of no throw to occur between two telephone nodes, the throw changing sign on either side of these points. But further experiments showed that this arrangement of the permanent magnetism was probably accidental, and due to the very currents employed in making the telephone observations. For when only very feeble currents had been used on a ring, these consequent poles were absent.

It is possible, as one would expect, to artificially make a minimum intensity position, at any point on a ring, by winding on a few turns of thick copper wire. But the fact that the phases on either side of such a point (found as before by means of two coils in circuit with a telephone) are the same, precludes the idea that the nodes can be due to Foucault currents.

Obviously, however, the phenomenon depends on some permanent peculiarity round the ring which happens to occur fairly regularly. What this peculiarity is, or how it is brought about, I have not yet been able to discover.

FRED. T. TROUTON.

OYSTERS AT THE ANTIPODES.

SO much attention has been given in England to the various questions connected with oyster-fisheries that it may be of interest to note some facts relating to the oyster-fisheries of our Australian kinsfolk. The subject was admirably dealt with in a lecture delivered by Mr. Saville-Kent before the Christchurch meeting of the Australasian Association for the Advancement of Science. This lecture is entitled "Oysters and Oyster-Culture in Australasia," and has been published separately.

Mr. Saville-Kent devotes attention chiefly to Australia and Tasmania, as, at the time when his lecture was prepared, he had not had an opportunity of personally studying the question in New Zealand. Beginning with Tasmania, where for five years he was officially connected with the oyster-fisheries, he points out that the oyster of Tasmania corresponds closely with the type *Ostrea edulis*, produced and cultivated in British waters. Formerly, this oyster was so abundant in Tasmanian waters, that, according to the report of a Royal Commission of Fisheries in 1882, about twenty years previously a quantity representing at current prices a retail value of no less than £90,000 had been exported in a single year to Victoria and New South Wales. At that time, oysters were so plentiful that it was a common practice to burn them in large quantities for the purpose of making lime. The strain was, of course, too severe, and by and by the Tasmanians found that, although there was still a demand for oysters, there was no longer a home-supply, and that it was necessary for them to go elsewhere for the commodity which they had so recklessly wasted. In 1884, when Mr. Saville-Kent reached the colony, the oyster-fisheries of Tasmania had for some years been an obsolete industry. Profiting by the information which had been made accessible through the International Fisheries Exhibition and associated Conferences in London in 1883, and by Prof. Hubrecht's testimony as to the oyster-fisheries of the Schelde, Mr. Saville-Kent recommended the establishment, in suitable localities, of efficiently-protected Government reserves, upon which breeding-stocks of oysters of the best quality should be carefully cultivated and permanently retained. These reserves were to fulfil the double purpose of breeding-centres, from whence the surrounding waters might be restocked, and also of model oyster-farms, around which private beds might be established on similar lines. The scheme recommended being approved, sites formerly associated with the most prolific oyster production were selected. The operations were necessarily conducted on a very modest scale. Oyster stock, suitable for laying on the reserves, could be accumulated only by slow and laborious processes, and some 20,000 to 50,000 oysters represented the approximate numbers that were gradually collected and placed under cultivation. In order that the largest possible amount of spat produced by the oyster stocks laid down might be caught, various methods were adopted, the principle being that which has been followed with so much success by M. Coste on the west coast of France. In addition to dead oyster-shells, or "cultch," which has, from the earliest days of oyster-culture, been recognized as representing a most natural and prolific catchment material for the adhesion of the spat, artificial collectors of various descriptions were introduced. In France, tiles cemented on their lower surfaces have been found

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